Treatment Variations of Hip Fractures in Alberta

Technical Report

Marilyn Cree, Ph.D.[1], Qian Yang, MSc.[2], Angela Scharfenberger, M.D.,[3] K.C. Carriere, Ph.D.[1]

1. Department of Mathematical Sciences, University of Alberta, Edmonton, Alberta, Canada;
2. Physician Services, Alberta Health and Wellness, Government of Alberta, Edmonton, Alberta, Canada;
3. Faculty of Medicine, University of Alberta, Edmonton, Alberta, Canada

Alberta Centre for Health Services Utilization Research

101-03741/

ACKNOWLEDGEMENT

The authors gratefully acknowledge the support provided by the Alberta Centre for Health Services Utilization Research, which conducts studies of how health services are used and delivered to inform health policy development and management of health service delivery. The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health & Wellness. ***The opinions and conclusions expressed in this paper are those of the authors and no endorsement by Alberta Health & Wellness is implied.***

The authors also wish to thank Alberta Health & Wellness for use of its administrative health services data.

Note: This research was supported in part by the Institute of Health Economics and the Alberta Heritage Foundation for Medical Research

For more information contact:

David Johnson, Coordinator
Alberta Centre for Health Services Utilization Research
22nd Floor, Telus Plaza North Tower
10025 Jasper Avenue NW
Edmonton, AB T5J 2N3
Ph: 780-415-0219
Fax: 780-422-2880
Email: david.johnson@gov.ab.ca

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

Background 1
Methods 1
Results 1
Conclusions 1

INTRODUCTION 2

MATERIALS AND METHODS 3

Selection of Participants and Variables 3
Statistical Methods 5

RESULTS 6

Temporal Trends 6
Table 1: Age and Sex Adjusted Arthroplasty and Mortality Percentages (1993/1994 – 1998/1999) 7
Preliminary Analysis 7
Table 2: Characteristics of Patients Undergoing Hemiarthroplasty and Total Hip Replacement (1993-1999) 8
Variation Among Hospitals 8
Table 3: Number of Procedures by Hospital and Regional Health Area, 1993-1999 9
Arthroplasty 9
Table 4: Logistic Regression Results to Predict Arthroplasty (n=4276) 10
In-Hospital Mortality 10
Table 5: Logistic Regression Results to Predict Mortality 11
Provider Results 11

DISCUSSION 11

REFERENCES 14

BIOGRAPHIES **15**
Marilyn Cree 15
Qian Yang 16
Angela Scharfenberger, M.D. 16
K.C. Carrierre 17

EXECUTIVE SUMMARY

Background

This study examined variation in treatment and in-hospital mortality between hospitals and years following a femoral neck hip fracture in Alberta.

Methods

Six years of data was obtained from the administrative files managed by Alberta Health and Wellness. Patients were included if they were aged 65+, admitted to hospital in Alberta with a femoral neck hip fracture and had undergone one of three surgical procedures: internal fixation, partial or total hip replacement.

Results

In-hospital mortality rates were similar across hospitals, with risks being higher for males, patients aged 80+ years, and those with a greater number of other serious medical conditions. Partial or total hip replacements were most commonly done, with combined rates varying from 58% to 77% among hospitals. Hospital stays associated with the partial or total hip replacements were significantly longer than those accompanying the surgical technique using an internal rod. Chances of undergoing a partial or total hip replacement varied from hospital to hospital for females and patients with a greater number of other serious medical conditions.

Conclusions

Regional variations in the surgical procedure performed suggest lack of agreement among Alberta's surgeons as to how best to treat femoral neck hip fractures.

INTRODUCTION

Femoral neck hip fractures comprise approximately half of the estimated 1.26 million hip fractures occurring annually worldwide(1). Unless the patient is very ill, surgery is done to repair a femoral neck fracture. The type of surgical procedure employed in repairing the hip fracture depends, among other things, on whether the fractured bone is displaced or not. If not displaced, an internal fixation (ie internal rod) procedure is the recommended treatment. To repair a displaced fracture, patients usually undergo a hip arthroplasty procedure (artificial bone prosthesis) – either a hemiarthroplasty (HA-one artificial bone prosthesis) or a total hip arthroplasty (THA-two artificial bone prosthesis). Approximately 64% of femoral neck repairs involve hip arthroplasties, 90% of these being hemiarthroplasties and the remaining 10% being total hip arthroplasties (1). It is generally assumed that better outcomes result from arthroplasty than from internal fixation, although the superiority of one treatment over another has not been clearly documented (2). In fact, one outcome study comparing internal fixation to hip arthroplasty reported that mobility, institutionalization, perceived health, hospital readmission, and mortality risk were similar for patients in both treatment groups, and, overall, arthroplasty patients were doing less well at one year following their hip fracture (3). Recently, however, the trend has been towards performing more arthroplasties.

With a lack of clear criteria upon which to base a decision, a surgeon's preference for hemiarthroplasty or internal fixation to repair a displaced femoral neck fracture may depend largely upon the importance the surgeon places on reoperation or function (4). This has led to large regional variations in the surgical treatment of femoral neck fractures. In Europe, percentages of arthroplasty repair for femoral neck fracture ranged from almost zero in two Swedish hospitals (5) to over 80% in Rotterdam (5) and Toulouse, France (6). One Canadian study reported a huge variation in the proportions of femoral neck fractures treated by hemiarthroplasty (9% to 83%) and total hip replacement (.5% to 38%) across counties in Ontario, with most of the variation being attributable to hospitals (7).

Femoral neck fractures have been referred to as the "unresolved orthopedic fracture" (8). Compared to internal fixation, arthroplasty is more costly and requires a longer operating time. Justifying these additional costs demands evidence linking arthroplasty with improved patient-defined outcomes such as function, health perception, and pain.

This study compares arthroplasty rates for femoral neck fractures across both time and hospitals, and investigates the extent to which treatment variations can be explained by patient and physician characteristics. Understanding current treatment variations is a first step towards developing a treatment protocol that will result in the best care for the hip fracture patient.

MATERIALS AND METHODS

Selection of Participants and Variables

Data examined in this study were collected by Alberta Health and Wellness for six fiscal years 1993/94 to 1998/99. Alberta is divided into 17 regions and each region is responsible for the delivery of health services to its residents. Apart from the provider information, all data was abstracted from the Alberta Morbidity File, which contains information on each hospital discharge. For this study, we obtained the following patient information from this database: sex, date of birth, regional health area of residence, date of hospital admission, date of hospital discharge, and whether or not the patient died in-hospital. Based on the International Classification of Diseases, ninth revision-clinical modification codes (ICD-9CM), we identified patients with a femoral neck fracture, and the number of serious medical conditions (comorbidities) contained within the 16 diagnosis fields from hospital separation records for each study participant. A patient was identified as having a serious medical condition if the hospital separation contained one of the diagnoses found to significantly impact health status (9;10). For each patient, the number of comorbidities was the total number of serious medical conditions on the hospital separation. Another variable collected from this file was the surgical procedure performed in repairing the hip fracture, based on the International Classification of Diseases Procedures codes. Finally, the following information from this file was used to link all the patient information to the provider information: a unique patient identification number (i.e.: the Anonymous Stakeholder Number (ASN)), the date of the procedure, and a hospital identification number identifying the hospital in which the procedure was performed.

To contribute to our understanding of the variations in rates, we included some physician characteristics. The Alberta Health and Wellness Stakeholder file was linked to the Alberta Health and Wellness Claims file to obtain provider information (surgeon's age, years since graduation, workload, and sex). This information was linked to the patient information via the ASN of the patient, hospital ID number, and date of procedure. Unfortunately, the health provider information was not available for 1993/1994, and was incomplete for the other study years because of problems with linking the data.

The codes used to identify patients suffering from a femoral neck fracture were those used in similar studies (7;11). That is, any patient with a discharge diagnosis corresponding to the ICD-9CM categories 820 to 820.2 was eligible for inclusion in the study. A diagnosis of hip fracture has been shown to be accurately coded in hospital separation abstracts (12). While these codes do not distinguish between displaced and undisplaced femoral neck fractures, internal fixation is the generally accepted treatment for an undisplaced femoral neck fracture. Based on this information, we assumed that only displaced femoral neck fractures were treated with arthroplasty.

Inpatient procedure codes of these patients were classified into total hip arthroplasty (code 8151), partial hip arthroplasty (code 8152), and internal fixation (codes 7855: no reduction; 7915: closed reduction; and 7935: open reduction) according to the International Classification of Diseases Procedures. To compensate for the possibility of a hemiarthroplasty being miscoded as a total arthroplasty, procedure codes 8151 and 8152 were combined to form the arthroplasty group (13). Patients included in this study were admitted to an Alberta hospital with one of the discharge diagnoses and inpatient procedures of interest. Patients were excluded if their treatment did not include one of these procedures.

While internal fixation is generally recommended for patients under the age of 65, treatment for patients between the ages of 65 and 85 is unclear (14). For this reason, we confined our analysis to patients aged 65 and over.

Statistical Methods

In comparing arthroplasty rates over time, age-sex adjusted provincial rates were calculated for each year, employing direct standardization using the 1998/1999 fiscal year as the standard. Because some patients underwent more than one procedure during the study period, the denominator of the rate could consist of the number of procedures (procedure-based) or the number of patients (patient-based). Since revisions were coded differently, these 118 (2.6%) patients were assumed to have new hip fractures. This prompted us to calculate procedure-based arthroplasty rates.

To attain stable estimates when examining arthroplasty and mortality variations across hospitals, data for the entire study period (1993-1999) was combined, and the analysis included only those hospitals performing hip surgeries over all six years. To assess whether age-sex adjusted arthroplasty or mortality rates varied significantly across hospitals, each hospital's rate was compared to the overall combined rate. The combined rate was a weighted average over hospitals selected, with the weight being the inverse variance of the hospitals estimated rate.

To ensure stable estimates of arthroplasty rates among providers, surgeons performing at least 20 hip repair procedures over the six years were included in the analysis. A cutoff of 20 was chosen in order to retain at least 85% of the procedure information for each hospital.

The dependent variables examined included: whether or not arthroplasty was performed (comprised of hemiarthroplasty and total arthroplasty) and whether or not the patient died while in the hospital. The input variables we considered were many of those examined in previous studies and found to be significantly associated with the dependent variables (7;11). While the association of these variables with mortality may be clear, the relationship of these variables to arthroplasty may be less obvious. Research has shown that bone quality influences a surgeon's decision regarding arthroplasty (15), and to some extent, both age and sex are proxies for bone quality. The number of medical conditions would be associated with function and rehabilitation potential, other concerns when considering a hip arthroplasty (4). The continuous input variables were categorized based on graphical analysis as follows: patient's age was classified into two groups: younger than 80 or 80+years; number of serious medical conditions was dichotomized into two or fewer versus three or more serious medical conditions.

While length of hospital stay was not included as an input variable, we considered it an outcome of interest in this study and examined the association with the dependent variables. Because the average hospital stay was fifteen days, length of hospital stay was divided into fifteen or fewer days versus sixteen days or more. For the provider information, the year of graduation was divided into three groups: 1975 or earlier, 1976 to 1983, 1984 or later.

Using the SAS Logistic procedure (version 7, SAS Institute Inc., Cary, NC), multiple logistic regression was used to examine the odds of mortality and the odds of having a hip arthroplasty on the included independent variables (age, gender, and number of serious medical conditions). For the arthroplasty analysis, a separate logistic regression was done for each hospital and the ten results were compared to an overall value to assess the consistency of risk estimates across hospitals. For the mortality analysis, eight logistic regression analyses were done: data from Red Deer, St. Mary, and Medicine Hat had to be combined due to low incidence rates. Individual logistic regressions could not be done on these three hospitals because they had too few outcomes. The results from the eight regressions were then compared to an overall risk estimate.

RESULTS

Temporal Trends

Over the fiscal years 1993/94 to 1998/99, 5,296 older adults sustained a total of 5,476 femoral neck fractures. Of these, 4,475 seniors (associated with 4,593 procedures) were included in the study because they underwent at least one of the treatment procedures under consideration. The average age of the 821 patients undergoing the 884 excluded procedures was 81 years and 73% were females. Similarly, the average age of the included patients was 81 years and 74% were females.

Overall, 231 of the 4,475 (5.2%) patients died in hospital. The provincial in-hospital age- and sex-adjusted mortality proportion showed little variation between 1993 and 1999, fluctuating between 4% and 6% annually (Table 1).

Of the 4,592 hip repair procedures examined, 3,264 (71%) were arthroplasties. After adjusting for age and sex, the proportion of arthroplasties performed in Alberta remained fairly stable between 1993 and 1999 (Table 1). While there was some variation in the proportion of males undergoing a hip arthroplasty each year, there was no evidence of a time trend. Between 68% and 70% of females underwent a hip arthroplasty each year.

Table 1: Age and Sex Adjusted Arthroplasty and Mortality Percentages (1993/1994 – 1998/1999)

HOSPITAL	Arthroplasty rate ratios††						Six-Year Arthroplasty Rate (n))†	Six-Year Mortality Rate (n)†
	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99		
Foothills	0.98	0.97	1.01	0.91	0.81	1.01	72.6 (562)	6.7 (553)
Rockyview	1.02	0.94	1.01	1.00	1.00	0.92	76.6* (633)	5.5 (611)
Peter Lougheed	1.01	0.99	1.07	1.09	0.98	0.80	74.5 (493)	5.5 (473)
Royal Alexandra	0.91	0.90	0.95	1.04	1.08	0.93	74.6 (862)	5.1 (844)
University of Alberta	0.93	1.00	1.09	0.95	0.95	0.92	71.7 (696)	4.0 (675)
Lethbridge	1.07	1.21	0.93	1.16	1.10	0.90	57.8* (293)	3.0 (286)
Medicine Hat	1.12	0.86	0.75	1.01	0.86	0.76	69.0 (189)	3.5 (182)
Queen Elizabeth	1.08	0.93	0.95	1.03	0.95	0.88	78.3 (150)	6.9 (147)
Red Deer	1.01	0.96	1.03	0.99	1.12	0.99	60.8* (318)	4.3 (317)
St. Mary*	0.52	0.83	1.00	0.87	1.17	1.09	59.7* (80)	5.5 (78)
Alberta	0.98	0.94	0.99	1.01	1.01	1.00	72.0 (4593)	
Alberta Mortality Rate (no. patients) †	6.4 (728)	4.1 (676)	4.0 (771)	6.0 (826)	5.9 (800)	5.3 (750)		4.8 (4475)

* Statistically different from the overall rate of 72%
†The numbers in parentheses indicate the number of procedures for arthroplasty rates and that of patients at risk for mortality rates.
†† Shown are the ratios against the six-year arthroplasty rate.

Preliminary Analysis

All of the patient characteristics were assessed for their association with in-hospital mortality and having a hip arthroplasty (Table 2). Males, those aged 80+ years, and seniors with three or more comorbidities appeared to be at increased risk of in-hospital death. Arthroplasties were more commonly performed in older patients and those with three or more medical conditions.

There was a significant association between length of hospital stay and arthroplasty, with a larger proportion of patients with long hospital stays undergoing arthroplasty rather than internal fixation ($p<0.001$). We did not compare length of stay by hospital because of differences in health care delivery among regions. For example, in regions with a subacute care system, patients are usually discharged to a subacute care facility after about nine to ten days. In regions without a subacute care system, patients average longer hospital stays. Mortality and length of hospital stay appeared to be unrelated (Table 2).

Table 2: Characteristics of Patients UndergoingHemiarthroplasty and Total Hip Replacement (1993-1999)

Characteristic	No. of Patients	% Arthroplasty (HA and THA)	% In-Hospital Death
ALL	4,474	71	5
AGE			
65-79 (%)	1,928 (43)	67	3.2
80+ (%)	2,546 (57)	74	6.6
GENDER			
Female (%)	3,283 (73)	72	4
Male (%)	2,546 (27)	74	8
NUMBER OF COMORBIDITIES			
<3 (%)	2,180 (73)	66	1.4
>= 3 (%)	1,191 (27)	76	8.6
LENGTH OF HOSPITAL STAY			
<16 Days (%)	3,274 (73)	69	4.7
≥ 16 Days (%)	1,200 (27)	77	6.0
PATIENTS WITH REPEAT PROCEDURES			
Two procedures (%)	117 (2.6)	71	1.3
Three procedures (%)	1 (0.0)	NA	NA

Variation Among Hospitals

While a total of 18 hospitals performed at least one hip procedure between 1993 and 1999, this analysis was restricted to the 10 hospitals performing hip repairs in all of the 6 years (Table 3). Combined, these 10 hospitals performed 93% (4,276) of all surgeries under consideration in this study.

Table 3: Number of Procedures by Hospital and Regional Health Area, 1993-1999

Hospital	Regional Health Authority	Number of Procedures (1993-1999)	Number of Patients (1993-1999)	In-Hospital Deaths (1993-1999)	Surgeons Performing 20 + Procedures (1994-1999)
Foothills	Calgary	562	555	35	7
Rockyview	Calgary	633	612	33	8*
Peter Lougheed	Calgary	493	473	25	7*
Royal Alexandra	Capital	862	845	42	13*
University of Alberta	Capital	696	675	26	10*
Lethbridge	Chinook	293	283	14	5
Medicine Hat	Palliser	189	183	6	2
Queen Elizabeth	Mistahia	150	146	11	2
Red Deer	David Thompson	318	315	14	3*
St. Mary	East Central	80	78	4	1

* Some of these physicians also performed smaller numbers of surgeries at other regional hospitals, but the bulk of the surgeries performed were at the specified hospital.

Arthroplasty

Six-year age- and sex-adjusted arthroplasty rates were tabulated by hospital along with the combined proportion of 72%: one hospital's rate was high (76.6%) while three other hospitals performed fewer arthroplasties than expected (ranging from 57.8% to 60.8%)(Table 1). To investigate whether older patients, females, and those with more comorbidities were equally likely to undergo hip arthroplasties in each hospital, we compared each hospital's rate with an overall rate. Compared to patients with fewer comorbidities, those with three or more medical conditions were more likely to undergo a hip arthroplasty, and the chances were higher at the Foothills Hospital (OR=2.4) than any of the other nine hospitals (OR=1.5). While females and males had approximately equal chances of undergoing hip arthroplasties in most hospitals (OR=1.19), there were significant variations across hospitals. That is, arthroplasties were less likely for females admitted to the Foothills Hospital (OR=0.6) and more likely for females in the Medicine Hat Hospital (OR=3.2) (Table 4). The patient's age appeared to be unrelated to the chances of undergoing a hip arthroplasty.

Table 4: Logistic Regression Results to PredictArthroplasty (n=4276)

Hospital		Age		Medical Conditions		Gender
	OR	Estimate (se)	OR	Estimate (se)	OR	Estimate (se)
Foothills	1.6*	0.490 (.197)	2.4*†	0.86 (.198)	0.6*†	-0.51 (.233)
Rockyview	1.4	0.362 (.19)	1.5*	0.38 (.198)	1.5	0.389 (.22)
Peter Lougheed	1.9*	0.663 (.21)	1.3	0.27 (0.21)	1.1	0.129 (.24)
Royal Alexandra	1.2	0.163 (.158)	1.3	0.26 (.159)	1.2	0.222 (.173)
University of Alberta	1.3	0.265 (.174)	2.1*	0.72 (.175)	1.3	0.24 (.195)
Lethbridge	1.2	0.183 (.259)	1.5	0.39 (.25)	1.8*	0.602 (.28)
Medicine Hat	1.6	0.5 (.322)	1.0	0.02 (.33)	3.2*†	1.15 (.364)
Queen Elizabeth	0.9	-0.143 (.407)	2.3*	0.83 (.425)	0.5	-0.69 (.457)
Red Deer	1.4	0.358 (.236)	0.9	-0.12 (.297)	1.1	0.07 (.25)
St. Mary	1.00	-0.02 (.46)	1.2	0.22 (.46)	1.0	0.00 (.51)
Overall	**1.36**	**0.32 (0.065)**	**1.53**	**0.428 (0.115)**	**1.19**	**0.175 (0.277)**

*Statistically significant at 0.05 level for each separate regression
†Statistically significant at 0.05 level from the overall rate

In-Hospital Mortality

The six-year age-and-sex adjusted in-hospital mortality rates were compared across hospitals (Table 1). Again, we compared each hospital's rate to the overall rate. In most hospitals, patients aged 80+ years had approximately twice the mortality risk of younger patients (OR=1.84). This risk was higher for those admitted to the Rockyview Hospital, where older patients were over five times as likely to die (OR=5.57). Whereas females and males had approximately equal risks of mortality in most hospitals (OR=0.708), the risk was reduced by almost 75% for females in the University of Alberta Hospital (OR=0.289) (Table 5). Although having three or more comorbidities was highly associated with in-hospital mortality rate (overall odds ratio=5.64), the geographical variation was found to be insignificant.

Table 5: Logistic Regression Results to Predict Mortality

Hospital	Age		Medical Conditions		Gender	
	OR	Estimate (se)	OR	Estimate (se)	OR	Estimate (se)
Foothills	1.39	0.328 (0.368)	9.52*	2.25 (0.74)	0.65	-0.436 (0.366)
Rockyview	5.57*†	1.72 (0.545)	3.33*	1.2 (0.419)	0.556	-0.588 (0.395)
Peter Lougheed	2.11	0.747 (0.467)	6.45*	1.86 (0.627)	0.47	-0.695 (0.435)
Royal Alexandra	1.81	0.595 (0.347)	13.31*	2.589 (0.729)	0.53	-0.63 (0.328)
University of Alberta	1.09	0.086 (0.435)	10.048*	2.307 (0.747)	0.289*†	-1.24 (0.412)
Lethbridge	7.095	1.95 (1.06)	5.244*	1.66 (0.78)	0.292*	-1.23 (0.57)
Queen Elizabeth	1.37	0.314 (0.68)	5.61*	1.72 (0.805)	0.50	-0.69 (0.659)
Medicine Hat, Red Deer, St. Mary	4.21*	1.437 (0.629)	5.34*	1.675 (0.483)	0.51	-0.675 (0.437)
Overall	**1.84**	**0.608 (0.561)**	**5.64**	**1.73 (0.311)**	**0.708**	**-0.346 (1.48)**

*Statistically significant at 0.05 level for the separate regression
†Statistically significant at 0.05 level from the overall rate

Provider Results

We had provider information on 3,238 (84%) of the 3,863 procedures performed between 1994 and 1999 in Alberta. Fifty-eight of the 88 providers performed a total of 20 or more hip procedures between 1994 and 1999, and these surgeons were accountable for 3,019 (78%) of all procedures done during the five-year period. The bulk of their procedures were performed in the hospitals performing surgeries over all six years (Table 2). Among these 58 surgeons, 56 were males, 24 had graduated prior to 1975, 21 had graduated between 1975 and 1983, and 13 had graduated between 1984 and 1991.

None of the surgeon's characteristics appeared to capture the underlying reasons for the observed variation in arthroplasty rates.

DISCUSSION

This study examined temporal trends and regional variations in treatment options and in-hospital mortality following a femoral neck fracture in Alberta. This study was unique in examining provider information and in conducting separate hospital-based analyses. In general, we found no indication of a time trend, although important regional variations in

arthroplasty rates emerged. The choice of arthroplasty over internal fixation appeared to vary across hospitals and hence across surgeons affiliated with hospitals. We were not able to pinpoint the factors within surgeons that influenced the variation. However, the variation was explained by some patient characteristics, and the relevance of these characteristics varied from hospital to hospital.

Overall, the mortality and arthroplasty rates were similar to those reported by others. Compared to a one-month mortality rate of 7% (16), we noted an in-hospital mortality rate of 5.2%, despite the somewhat shorter time period (approximately two weeks on average).

Seventy-one percent of femoral neck fractures were treated with arthroplasty. While this proportion was slightly higher than the 64% reported in an American study (1986-1989) (16), our result seemed reasonable, as the proportion of arthroplasties was shown to have increased between 1986 and 1992 (7).

The significant regional variation in arthroplasty rates was supported by comparable findings in Ontario (7). These authors noted that the regional variations could not be explained by hospital caseload or by whether the hospital served primarily an urban or rural population. While both the American and Ontario studies observed that older patients and females were more likely to undergo hip arthroplasties, we found the relevance of these characteristics varied by hospital. Across hospitals, the chances of undergoing a hip arthroplasty were increased for older patients (OR=1.36), and varied by hospital for females and patients with three or more medical conditions.

This study had limitations, one of the most important being the inability to distinguish between displaced and undisplaced fractures. Assuming our sample consisted of approximately equal numbers of displaced and undisplaced femoral neck fractures (17), the proportion of arthroplasties for displaced femoral neck fractures would be much larger than reported here because almost all undisplaced fractures should be treated with internal fixation. We also lacked clinical information on bone quality (17) and functional mobility (4), which have been reported to impact the surgeon's treatment decision. As the Ontario authors note, however, if surgeons were consistently basing their decisions on clinical factors, there should be more similarity across hospitals.

In the Ontario study, the authors concluded that large treatment variations across regions were indicative of a lack of professional consensus regarding the best treatment for displaced femoral neck fractures. With the findings in Alberta being comparable to those of Ontario, we are led to the same conclusion. We found treatment variations across some hospitals (and consequently surgeons in Alberta) that were not explained by the surgeon or patient characteristics we considered. To ensure that each patient is receiving the most appropriate treatment, it is important to understand how treatment decisions are being made. A surgical protocol needs to be developed, based on outcomes associated with each treatment. While the incidence of in-hospital mortality was low, the geographic variations warrant further investigation on an individual hospital basis. Since longer term mortality appears to be unrelated to treatment choice (2), we suggest that other outcomes may be more relevant to consider when making a treatment decision. Functional outcomes, quality of life, reoperation rates, and long term care placement remain to be examined. In linking the surgical procedure to these patient-defined outcomes, we can maximize the patient's chances of recovery and quality of life.

REFERENCES

(1) Mendenhall, S., Mendenhall, R., Hip Fractures: A Case Study. Orthopedic Network News; 1996: 10-13.

(2) Lu-Yao, G.L., Keller, R.B., Littenberg, B., Wennberg, J.E., Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. J Bone Joint Surg Am. 1994; 76(1):15-25.

(3) Burns, R.B., Moskowitz, M.A., Ash, A., Kane, R.L., Finch, M., McCarthy, E.P., Do hip replacements improve outcomes for hip fracture patients? Med Care. 1999; 37(3):285-294.

(4) Chua, D., Jaglal, S.B., Schatzker, J., An orthopedic surgeon survey on the treatment of displaced femoral neck fracture: opposing views. Can J Surg. 1997; 40(4):271-277.

(5) Berglund-Roden, M., Swierstra, B.A., Wingstrand, H., Thorngren, K.G., Prospective comparison of hip fracture treatment. 856 cases followed for 4 months in The Netherlands and Sweden. Acta Orthop Scand. 1994; 65(3):287-294.

(6) Lyritis, G.P., Johnell, O., Orthopaedic management of hip fracture. Bone. 1993; 14 Suppl 1:S11-S17.

(7) Jaglal, S.B., Sherry, P.G., Chua, D., Schatzker, J., Temporal trends and geographic variations in surgical treatment of femoral neck fractures. J Trauma. 1997; 43(3):475-479.

(8) Obrant, K., Orthopedic treatment of hip fracture. [Review] [31 refs]. Bone. 1996; 18(3 Suppl):145S-148S.

(9) Pope, G.C., Medical conditions, health status, and health services utilization. Health Serv Res. 1988; 22:857-877.

(10) Roos, N.P., Carriere K.C., Friesen, D., Factors influencing the frequency of visits by hypertensive patients to primary care physicians in Winnipeg. CMAJ. 1998; 159(7):777-783.

(11) Burns, R.B., Moskowitz, M.A., Ash, A., Kane, R.L., Finch, M., McCarthy, E.P., Variations in the performance of hip fracture procedures. Med Care. 1997; 35(3):196-203.

(12) Fisher, E.S., Whaley, F.S., Krushat, W.M., Malenka, D.J., Fleming, C., Baron, J.A., et al. The accuracy of Medicare's hospital claims data: progress has been made, but problems remain. Am J Public Health. 1992; 82(2):243-248.

(13) Fox, K.M., Reuland, M., Hawkes, W.G., Hebel, J.R., Hudson, J., Zimmerman, S.I., et al. Accuracy of medical records in hip fracture. J Am Geriatr Soc. 1998; 46(6):745-750.

(14) Robinson, C.M., Saran, D., Annan, I.H., Intracapsular hip fractures. Results of management adopting a treatment protocol. Clin Orthop. 1994;(302):83-91.

(15) Barnes, R., Brown, J.T., Garden, R.S., Nicoll, E.A., Subcapital fractures of the femur. A prospective review. J Bone Joint Surg Br. 1976; 58(1):2-24.

(16) Lu-Yao, G.L., Baron, J.A., Barrett, J.A., Fisher, E.S., Treatment and survival among elderly Americans with hip fractures: a population-based study. Am J Public Health. 1994; 84(8):1287-1291.

BIOGRAPHIES

Marilyn Cree

Master of Science (Statistics) (University of Alberta)

Ph.D. Medical Sciences / Public Health Sciences (Epidemiology) (University of Alberta)

Research Associate, Department of Mathematical Sciences, University of Alberta. Currently involved in health services research using administrative files maintained by Alberta Health and Wellness. Also currently doing some outcomes research related to hip fractures in older adults.

Contact information:

632 Central Academic Bldg, Department of Mathematical Sciences,
University of Alberta,
Edmonton, AB
T6G 2G1
Email: mcree@ualberta.ca
Phone: 780-492-0291
Fax: 780-492-6826

Qian Yang

Master of Science (Statistics) (University of Calgary)

Specialist, Physician Services, Alberta Health and Wellness

In my work, I perform data extraction and analysis of the administrative health service data and communicate with researchers at the University of Alberta to study the pattern of physician services delivery and consumption.

I am also responsible for developing simulation models of physician resources and medical services to support evidence based decision making.

Contact Information:

Physician Services
Health Workforce Services
Alberta Health and Wellness
17th floor, Telus Plaza North Tower
10025 Jasper Avenue
PO Box 1360 STN Main
Edmonton, AB
T5J 2N3
Phone#: 427-2833

Angela Scharfenberger, M.D.

Completed BSc. in Physical Therapy with distinction from the University of Alberta in 1991. She then worked for two years as a therapist before returning to study Medicine.

She graduated from the University of Alberta, Faculty of Medicine in 1997, with MD with distinction and honors in research. Currently she is in her fourth year specialty training in Orthopedic Surgery.

Contact Information:

Email: ascharfe@ualberta.ca

K.C. Carrierre

Ph.D.-Statistics, Wisconsin-Madison, 1989

Professor of Statistics, University of Alberta since 1996.

Assistant professor at the Universities of Iowa (1990-1992) and Manitoba (1992-1996)

Director of Statistical Consulting Center, University of Iowa (1990-1992).

K.C.'s areas of research include multivariate methods, design and analysis of repeated measures data, missing data, and multivariate Behrens-Fisher problems.

K.C.'s area of application is in health services research, where her contribution in this area led her to win the National Health Scholar Award (1996-2001) from the National Health Research and Development Program (NHRDP). She is a Senior Scholar with Alberta Heritage Foundation for Medical Research (AHFMR) (1999-2004) and is currently funded by NSERC, MRC, NHRDP, AHFMR, and NCIC.

K.C. is an elected board member of the Western North American Region of International Biometrics Society (2000-2002), past member of its regional advisory board, elected Executive member for the Section on Health Policy Statistics of the American Statistical Association (1999-2001).

K.C. organized and chaired invited and contributed paper sessions at major national and international conferences, including the recent Edmonton Statistics and Health conference in June 2000.

Contact Information:

632 Central Academic Bldg,
Department of Mathematical Sciences
University of Alberta
Edmonton, Alberta
T6G 2G1
Email: KC.Carriere@ualberta.ca
Phone: 780-492-4230
Fax: 780-492-6826